M.O. 294.

The Meteorological Magazine

Air Ministry :: Meteorological Office

Vol. 62
Jan. 1928
No. 744

LONDON: PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE

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Effect of the Gale of October 28th on Electrical Transmission Lines

In last month's *Meteorological Magazine* Mr. Crichton gave an account of the gale which occurred over the British Isles on October 28th last. Since that account was written attention has been drawn to a peculiarity of the gale which will be of interest to readers of the magazine.

A few days after the gale a number of electrical engineers wrote to enquire whether there had been any abnormal electric or magnetic phenomena accompanying the gale, for considerable trouble had been experienced with overhead transmission lines during and after the gale. In all cases the trouble had been the same: the automatic switches which are set to break the current when it exceeds a definite amount were constantly in action, indicating an excess current in the lines.

The gale commenced soon after midday on Friday, October 28th, reached its maximum at midnight and was practically over by 7 a.m. on Saturday morning. The surprising point in the reports received from the engineers was that while the trouble commenced in south Wales on the Friday evening, when the gale was at its height, no trouble was experienced in the Midlands until Saturday, when the gale had been over nearly 12 hours. The trouble continued everywhere until the early hours of Sunday morning, when it disappeared as mysteriously as it had appeared.

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An examination of the electrograms at Kew and Eskdalemuir showed that there were no abnormal electrical effects and no magnetic storm was reported. It was clear, therefore, that the trouble was not due to atmospheric electricity or to terrestrial magnetism. In view of the difference in time of the commencement of the trouble in south Wales and in the Midlands, it was difficult to see how any meteorological factor could be the cause.

The first clue to the solution of the problem was contained in a letter from Mr. Parsons, the observer at Ross-on-Wye, in which it was stated :—

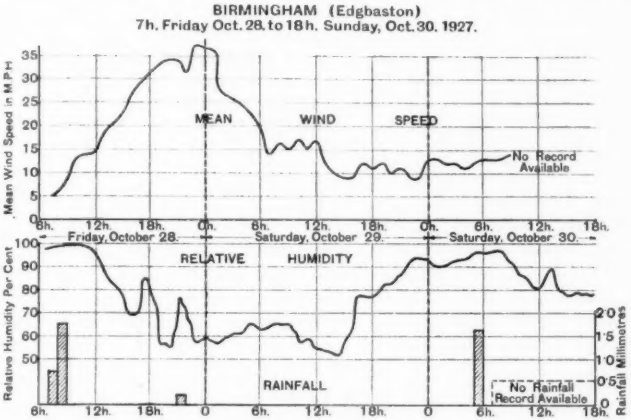
> " A curious thing occurred with the gale of the 28th/29th. On the morning of the latter date I found the lens of the sunshine-recorder covered with a ' smeary ' substance like mud or butter, the ball appeared non-transparent as if ' frosted.' I rubbed my finger on the ball and on putting it to my tongue noticed a strong salty taste. Some friends of mine experienced a similar deposit on their windows (facing west and southwest). The northeast part of the lens was hardly affected. The air was very dry at the time (humidity 60 per cent. and less).
>
> " I have had similar experience before with strong winds (especially from west) and low humidity, but never so pronounced as on this last occasion.
>
> " The ' smeary ' substance, moreover, was difficult to remove all at once. A subsequent fall of rain washed the last traces away.
>
> " Could the ' salt ' have been due to sea-spray borne by the gale from the Bristol Channel (22 miles away as the crow flies) ? "

An examination of the records from a number of stations showed that when the gale set in the air became very dry, the relative humidity falling to 50 per cent. in places. The air remained dry after the gale was over, but at about 4 p.m. on Saturday there was a rapid rise in relative humidity which rose in the course of an hour or two from 50 to 80 per cent., and then continued to rise until the air became nearly saturated. The curves of wind velocity, relative humidity and rain at Birmingham are shown on the accompanying diagram. The cause of the engineers' trouble now became clear, and the following explanation, which has been accepted by all the engineers, was given.

During the gale, which was from the southwest, great quantities of spray were blown up by the wind all along the west coast. The spray was carried inland by the wind and coated the insulators of the power lines in south Wales with a layer of salt water which practically short circuited them, so that the safety switches came into action. As the spray-laden wind passed inland the water was evaporated owing to the low humidity of the air. By

the time the air had reached the Midlands the spray had been reduced to salt crystals.

Sea salt is hygroscopic; therefore, the crystals remained sufficiently damp to stick on the insulators of the power lines in



the Midlands, but the coating of salt was too dry to destroy the insulation completely. When the air became damp on Saturday evening the insulation failed here also, just 24 hours after the failure in south Wales. In the early morning of Sunday rain became general; this washed the insulators clean and the trouble was over.

In connexion with this experience it is interesting to consider what quantities of salt must be spread all over the country side during our frequent southwesterly gales.

The Cold Spells of December, 1927

By C. K. M. Douglas, B.A.

During the second half of November and the early part of December, there were several periods when high pressure over Scandinavia caused easterly winds over central and western Europe. There was a good deal of frost over Germany, but the cold air was only a shallow layer, and when it reached the British Isles its temperature was consistently above the freezing point, with dull weather. About December 12th a very large anticyclone came down from the northward between north Greenland and Spitsbergen, and eventually covered Iceland and Scandinavia. In consequence a great outbreak of genuine polar air spread over the whole of Europe except Spain, reaching the

British Isles from the east. On December 14th a depression moving east-south-east across our southwest districts caused a snowfall over central and northern England, Wales, and the extreme south of Scotland (6 in. at Cranwell), most of which lay for a week. The very cold air reached eastern England on the 16th and soon spread over the whole country, and though, of course, the temperature was higher in the extreme southwest than in other districts, it was much below the normal. During the next few days screen minimum temperatures below 20° F. were rather frequent (*e.g.*, 5° F. at Balmoral on the 17th and 18th, 9° F. at Nairn on the 18th, 15° F. at Croydon and Shoeburyness on the 19th), but the coldness of the days was the most marked feature, the temperature being continuously below the freezing point for five days at many places over a large area. Such spells of cold days were frequent between 1890 and 1895, but have been very rare since then, especially in the south, though the cold spell of early 1917 was much longer, with some colder nights.

The very cold period from December 16th to 20th was accompanied by occasional snow, but amounts were mostly trifling except over a comparatively narrow strip up the east coast, where observers reported a few inches of dry snow lying right down to sea level. This unusual occurrence may be attributed to very cold air aloft, the temperature being down to 5° F. at 5,800 feet over Farnborough (Hants) on the 19th.

On the 20th the Scandinavian anticyclone decreased in intensity and passed away quickly southeastward, while a deep Atlantic depression approached the southwest of Ireland. In consequence mild air came in quickly from the southwest and a "glazed frost" occurred in London and many other parts of England, which caused great inconvenience and numerous street accidents. At Croydon the temperature in the early part of the night fell to 19° F. in the screen and 12° F. on the grass, and the rain began to fall at about 1.30 a.m., with the air temperature still below the freezing point. Fortunately the rainfall was small, averaging about 3 mm. (0·12 in.) in London before 7 a.m., but, nevertheless, the glazed frost was probably the worst which has occurred in the Metropolis since January 17th, 1903, when there was a very similar development.* It would be interesting to know whether a really severe "ice storm" has ever been recorded in this country. How serious the effects of such storms can be in the United States is well shown by some remarkable photographs in the *Monthly Weather Review* for February, 1922.

On the previous day (December 20th) there had already been a large rise of temperature in the upper air, amounting to no less than 25° F. at about 5,000 feet over Farnborough in 28 hours,

* See *British Rainfall*, 1903, p. [4].

a large inversion having developed between 3,000 and 4,000 feet. On the morning of the 21st an inversion of 20° F. was observed at Utrecht between the ground and 3,300 feet, and both on the 20th and 21st there was very dry air above the inversions at Utrecht, indicating that the air had descended and been warmed by compression. Such warm dry air at about 3,000 feet is always found at the western boundary of an anticyclone (on the 20th the anticyclone still included Holland and southeast England within its boundaries), and there can be no doubt that it played an important part both in preventing snowfall and in limiting the amount of precipitation, which was small (except in the southwest districts) considering the pronounced nature of the "warm front" at the earth's surface (see fig. 1).

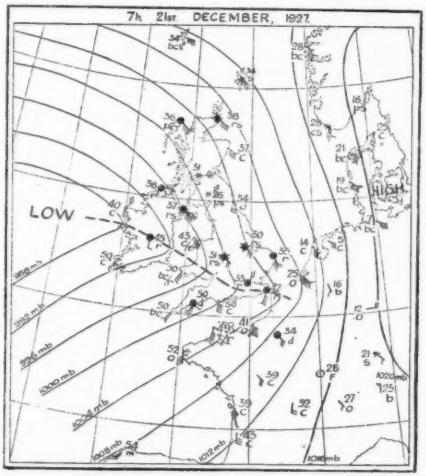


FIG. 1. Chart for the morning of the glazed frost.

On the following day, December 22nd, a very deep depression crossed the British Isles with heavy rainfall generally. In the rear of this system cold northeasterly winds spread back from Scandinavia across our northern districts, with renewed frost and snow on the high ground after a very short break. A "polar front" was practically stationary over southern England on the 24th, and during the following night a deep depression developed over the western part of the English Channel. On Christmas day there was snow in the Midlands but continuous heavy rain in the south of England. Towards evening the cold air spread southwards (see fig. 2) and the rain turned to snow, which fell heavily throughout the night over nearly the whole of southern England, and throughout Boxing Day and the following

night in the southeastern counties. Precipitation for the 48 hours from 7h. 25th exceeded 40 mm. (1·6 in.) at several stations, and reached 60 mm. (2·4 in.) at Lympne, in southeast Kent, but much of this fell as rain; the snow did not reach Lympne until the 26th. The mean depth of the snow exceeded a foot on the higher ground over a large area, but near sea level there was considerably less, much of it having melted. At some places on the east and southeast coasts there was no snow lying. The

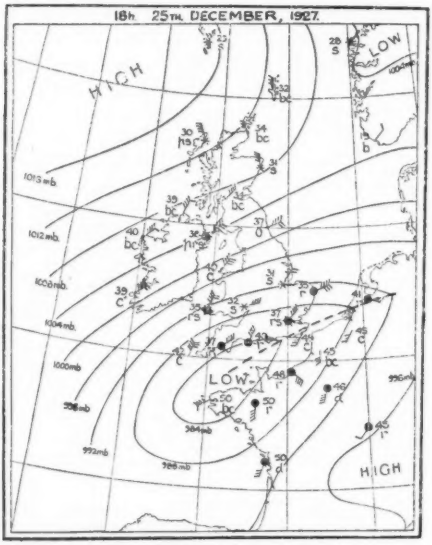


FIG. 2. Chart for evening of Christmas Day, the commencement of the great snowstorm over southern England.

snow was of the soft clinging type and broke down numerous overhead wires and branches of trees wherever there was shelter from the wind. In spite of this there was very severe drifting, with serious interruption of rail and road communication. The northeast wind was practically up to gale force inland at exposed places, and winds of this strength will drift any snow which is not water-logged or crusted. The strong winds continued till the 29th with further drifting, the weather being fine and frosty. Drifts as deep as twenty feet were reported from Salisbury Plain, while broad drifts of closely packed snow of about six feet in depth were very numerous, with sastrugi and small cornices. Some villages were isolated for days, and many of the main roads were blocked till the New Year.

Returning to fig. 2 for a more detailed study, we may note the dotted line marking the polar front, which had become much sharper during the afternoon, and was being pushed slowly southeastwards. The deep depression over the western part of the English Channel moved slowly southeastward and filled up, and a large anticyclone came in over northern Scotland and increased greatly in intensity, maintaining the strong northeast to east winds in southern districts, with a prolonged gale in the English Channel. Subsequently the anticyclone moved slowly eastward across Scandinavia, and milder weather spread in over the southwest districts on the night of December 30th, but only became general on the night of January 1st, when an intense depression skirted our northwest coasts. Further snow occurred in some districts on December 31st, notably in Wales, the Midlands and London, but near the south coast of England there was rain. When the strong winds died down there was some severe frost, the screen minimum being 13° F. at Croydon on the morning of December 30th and 11° F. at Eskdalemuir on the morning of January 1st.

To find a parallel to recent conditions in southern England, one must go back to the historic storms of January 1881 and March 1891. It may be noted that the 1881 storm immediately followed severe frost, and was accompanied by a lower temperature than that of 1927, so that fine powdery snow drifted about even in the streets of London.

Weather and Antiquaries

The publication by the Royal Meteorological Society of a paper by Mr. G. M. Meyer on the early history of water-mills in east Kent, and its bearing on variations of rainfall in the eleventh to fourteenth centuries,* affords an opportunity of calling the attention of antiquaries and historians to the contributions which they may sometimes be able to make to British climatology. Mr. Meyer's contention is that records of water-mills in Domesday and in mediæval law-suits show that the streams of east Kent were more powerful at the end of the eleventh century than they are to-day, and that the decrease was most rapid about 1275. There is some other independent evidence to the same effect. For example, a count of the British records of storms and floods on the one hand, and of droughts on the other hand, shows that from 1051 to 1250 there were recorded 23 floods and 21 droughts, while from 1251 to 1400 the records give 14 floods and 27 droughts. Another happening which may have some bearing on changes of rainfall is that in the thirteenth or fourteenth century the Little

* Early Water mills in relation to changes in the rainfall of east Kent. By G. M. Meyer. *London, Q.J.R. Meteor. Soc.*, 53 (1927), p. 407.

Hundred River, in Suffolk, was closed by a shingle bar which grew across its mouth, one possible explanation being that owing to a decrease of rainfall the stream ceased to be sufficiently powerful to keep clear a channel to the sea.

Each of these three lines of evidence, taken alone, may be susceptible of some explanation other than a change of rainfall. The flow of the east Kent streams may have been affected by some obscure factor which Mr. Meyer has not taken into account, or he may have made insufficient allowance for the factors, such as underground drainage, which he has included. The change in the ratio of floods to droughts may simply result from the operation of chance in the making and preserving of records. The blocking of the Little Hundred River may be due to a change in the currents of the North Sea, and have nothing to do with the rainfall. But the three pieces of evidence together, all pointing to a decrease of rainfall at about the same time, have a cumulative value, and add greatly to the probability that the suspected decrease was real.

The water-mills of east Kent cannot be an isolated instance. All over the country there must be similar records of the past which have a bearing on the climatic conditions of Great Britain before the commencement of instrumental meteorology. No doubt a great many such have already come to the notice of antiquaries who, being engaged in some definite line of research, have not cared to follow up what seem to be side issues. It may be that some particular fact, taken by itself, is meaningless, but taken in conjunction with similar facts from other parts of the country, it may become significant. Mr. Meyer has suggested an instance from the history of the Brent marsh on the River Brue in Somersetshire. This marsh had been drained some time before 1304, but the drainage works had been allowed to fall out of repair. From 1304 to 1335 new drainage works were carried out. This may mean nothing, but if it appears that the drainage works of other marshes in different parts of the country were also allowed to fall out of repair in the last half of the thirteenth century and repaired early in the fourteenth, it would suggest the intercalation of a relatively dry period between two periods of heavier rainfall.

In suggesting to antiquaries and historians that they should note and publish such records which may have a bearing on weather conditions, one is not asking them for a disinterested service. Climatic conditions form part of the stage on which the drama of British history has been carried out. History is not only a record of wars, rebellions and the enactment of laws; behind all these are the variations of the harvests, the price of corn, and all those factors which make the difference between content and unrest in an agricultural population. When the

record is more fully known, one may find that the villainy of a bad king was the villainy of the weather, or that a reign of happy memory happened to coincide with a series of good seasons. Such changes, too, may have their influence on the growth of religious movements. A picturesque example occurs in Bede's *Ecclesiastical History of England*, Book IV., Chapter 13*; "But Bishop Wilfrid, while preaching the Gospel to the people (the South Saxons, A.D. 681), not only delivered them from the misery of eternal damnation, but also from a terrible calamity of temporal death. For no rain had fallen in that district for three years before his arrival in the province, whereupon a grievous famine fell upon the people and pitilessly destroyed them . . . But on the very day on which the nation received the Baptism of the faith, there fell a soft but plentiful rain, the earth revived, the fields grew green again, and the season was pleasant and fruitful." This incident will be familiar to readers of Kipling in the story of "The Conversion of St. Wilfrid." The duration and severity of the drought are no doubt exaggerated, but any further evidence would be very welcome.

OFFICIAL NOTICE

Precipitation

Difficulties have arisen from time to time in regard to the meaning of certain words such as "continuous," "occasional," &c., in connexion with precipitation.

The following notes are a summary of the rules which have been drawn up for the guidance both of the observers who make the reports, and of the meteorologists who interpret the reports.

Use of the word "continuous."

Strictly speaking, the word "continuous" is not appropriate to a report of present weather, but as the present weather code covers the weather of the past hour and no weather before that period, the word "continuous" for the present weather code must be decided by what has happened in the past hour. All the observer therefore has to do is to decide whether the rain (precipitation) which he is reporting appears to him to be continuous or not in view of the experience of the past hour.

In reports of past weather, a break of only ten minutes' duration in a period of continuous rainfall can be disregarded, but a break of half an hour must be taken into account. The duration of precipitation necessary to justify the use of the word "continuous" in reports of past weather cannot be rigidly fixed. If it rained without a break for two hours it should undoubtedly be described as "continuous rain." If it rained

* A. M. Sellar's translation, London, 1907, p. 246.

for only half an hour it would not be called continuous rain. If it rained for an hour in the middle of a period without rain, it would not be necessary to describe it as continuous, *e.g.*, the description in Beaufort letters o, or, o, would be appropriate. If, however, the hour's rain came at the beginning of a period, and was the continuation of continuous rain which had been reported in the last report, it would still be reported as continuous rain in the new report.

Occasional Precipitation—Showers.

In general, showers are of short duration, and the fair periods between the showers are usually characterised by definite clearances of the sky. The clouds which give the showers are isolated clouds. The precipitation does not usually last more than fifteen minutes, although it may sometimes last for half an hour or more.

Occasional precipitation, on the other hand, usually lasts for a longer time than showers, and the weather in the periods between the precipitation is usually cloudy or overcast. The experienced observer will usually decide from the type of cloud which description to use.

Drizzle—Slight rain.

Drizzle is not " rain in small amount," but " precipitation in which the drops are very small." Slight rain, on the other hand, is precipitation in which the drops are of appreciable size (they may even be large drops), but are relatively few in number. Observers should decide from the combined effect of the number and size of the drops whether the precipitation is slight, moderate or heavy.

There are some occasions when rain is observed to be falling through drizzle : both the drizzle and the rain should be noted in the register.

Discussions at the Meteorological Office

The subjects for discussion for the next meetings will be :—

January 30th. *Les sondages aérologiques par avion et la théorie des cyclones de Bjerknes.* By J. Jaumotte (Bruxelles, Ciel et Terre, 43, 1927, pp. 31-36 and 49-54). *Opener*—Mr. E. V. Newnham, B.Sc.

February 13th. *Wolken und Gleitflächen.* By G. Stüve (Lindenberg, Arbeit. Preuss. Aeron. Obs., 15, 1926, pp. 214-224) and other papers. *Opener*—Mr. R. F. Budden, M.A.

Royal Meteorological Society

The monthly meeting of this Society was held on Wednesday, December 14th. at 49, Cromwell Road, South Kensington,

Sir Gilbert T. Walker, C.S.I., F.R.S., President, in the chair.

Sir Napier Shaw, R. G. K. Lempfert and E. E. Austin.—International Commission for the Upper Air; Report on the International Days of 1923.

A specimen volume was shown consisting of four parts, the first an introduction, regulations laid down by the Commission, and a list of stations in all parts of the world which may contribute information; the second a list of data for each international day and maps of distribution of pressure over the northern and southern hemisphere for that day; the third a tabular statement of the data for the upper air reported to the Commission; and the fourth a graphical representation of the results of registering balloons on an entropy diagram. The paper explains the way in which the details of the maps, tables and diagrams were arrived at as a development of the ideas expressed in the *Réseau Mondial*, which is published annually by the Meteorological Office on the lines of the work on *Dynamic Meteorology and Hydrography* by Prof. V. Bjerknes and others. The volume contains the first maps of the distribution of pressure for the whole globe and indicator-diagrams for expressing the energy relations of the atmosphere as disclosed by observations with registering balloons.

Correspondence

To the Editor, *The Meteorological Magazine*

The Storm of October 28th—29th, 1927

I had been hoping to see an account of the storm of October 28th-29th, and have now read the account of it by Mr. J. Crichton in your last number.

This laboratory has for a considerable time maintained in constant operation on the Varne Lightvessel, a long period current meter, which is customarily left down working at the depth of about 6 fathoms for periods of three lunar days. This lightvessel is situated roughly midway between Folkestone and Boulogne, and the instrument in use there serves to register the "make" of water through the Straits of Dover, over and above the oscillatory streams due to the tides.

We have amassed a large amount of data relative to the variation of the currents with changing winds and barometric pressure distributions, but the currents in advance of, and at the time of occurrence of, this storm seem to be of more than usual interest.

It is not possible to go into any detail here, but it may interest your contributor and some of your readers to see the following figures relating to the currents registered at the time in the

Straits of Dover. No doubt, a consideration of wind and pressure distribution would be valuable in this connexion.

Three-day Period.	Current (towards true direction).
(15-18) October, 1927	1·6 miles per day N. 8° E.
(19-27) ,, 1927	2·5 ,, ,, N. 22° E.
(22-25) ,, 1927	6·6 ,, ,, N. 52° E.
(25-28) ,, 1927	10·1 ,, ,, N. 54° E.
(28-31) ,, 1927	7·3 ,, ,, N. 42° E.
31st October to 3rd November, 1927	3·8 ,, ,, N. 45° E.
(4-7) November, 1927	2·6 ,, ,, N. 38° E.

It is very interesting to note the waxing and waning of the residual current with its maximal value at the time of the storm. The fact that the observations refer to three-day periods, results in the actual current at the precise time of chief interest being masked. No doubt the current was much stronger for one particular day, but, in any case, the net flow of water in the three-day period was abnormally large.

Only once in three years has a stronger flow of water been registered at the Varne Lightvessel. This was during the period 19th to 22nd of November, 1926.

J. N. CARRUTHERS.

Fisheries Laboratory, Lowestoft, Suffolk. December 29th, 1927.

Star-shaped Snowflakes

There were slight showers of snow here in the early morning hours of December 14th. In the thin sprinkling of snow which was lying at 7h. there were numerous crystal aggregates in the form of regular six-pointed stars. The diagonal measurement of the largest stars was about four to five millimetres. Similar stars were observed among the small snowflakes which fell at 9h. on the same day. The speed of the north-easterly wind did not exceed 15 m.p.h. at the surface. The air temperature was 32·1° F. at 9h., the minimum read at 7h. being 30·0° F.

Star-shaped snowflakes such as described may be fairly common, but this is my first experience of them.

H. W. L. ABSALOM.

The Observatory, Eskdalemuir, Langholm, December 15th, 1927.

Mirage at Sea

Mr. W. R. Butterfield (the Observer at Hastings) reports that on December 16th during "most of the afternoon a form of mirage occurred off Hastings. Ships passing up and down the Channel appeared to be raised above the horizon, and their inverted images were clearly visible below. I could not myself see the French coastline, but other observers declared that they had seen it."

Miss C. M. Botley, a well-known resident at Hastings, adds to the above account that " these observations were made between 15h. and 16h., and that the afternoon was more or less cloudy with a north-easterly wind and very good visibility. Unfortunately it was impossible to obtain the sea temperature. There had been snow in the morning."

The maximum temperature as recorded in the screen that day at Hastings was 34° F.

Sunset Colours and Cloud Forms as Aids to Weather Forecasting

Being on holiday at Clevedon, Somerset, from September 6th to 20th, I availed myself of the opportunity of forecasting from sunsets and cloud forms where it is claimed Turner gave us some of his fine examples. I was rewarded with one of the most brilliant sunsets I have seen for many a long year on the 9th, showing the sun setting between parallels of lenticular stratus interspersed with golden yellow and red colours, and I concluded rain would follow. The barometer was unstable, and the wind backing or veering, all giving confidence to such a forecast. On the 19th the sun went down as a great enlarged disc and the after glow cast yellow and red on cirro-stratus cloud ; rain fell in the morning of 20th, but the day was bright and fair.

At home on September 28th in the early evening I was struck by the appearance of a remarkable cloud formation, a long line of boat-shaped front with beaded cumulus edge and stratus base, stretching from south to north, and in the centre nearest north squares of stratus on front edge with parallels of stratus strips on each side of square with frilled edges ; just previously I had noticed scud cloud, medium and small moving from south to north. I concluded a gale would follow, it did on the 29th with rain, the front formation reminding me of a Noah's Ark cloud I had seen at Hastings in July, 1922, when a great gale followed. On the 29th I noted yellow and red sunset after rain, and I decided for light showers with fair periods ; the 30th was fine, with two light showers in afternoon of 0·02 in. I make use of instruments by daily observation and forecasts at sunset, cloud formation and sunset colours affording valuable assistance in successful results.

HENRY A. ROGERS.

31, *Fernbank Road, Redland, Bristol. October 4th*, 1927.

Ground Horizontal Visibility and Convection

In the *Meteorological Magazine* for April, 1924, p. 63, and for December, 1925, p. 260, were given the results of an investigation

into the relationship between upward convection currents and ground horizontal visibility at 13h., and that investigation has now been continued over a total of eight summers, 1920-1927 inclusive. As in the previous notes, the criterion for the presence of convection currents upward is taken in the continued investigation to be the presence of cumulus or cumulo-nimbus cloud at or about 13h. The extended results obtained are shown in the accompanying table, and further emphasise the conclusion previously arrived at, that convection days are more likely to be accompanied by good visibility, that is, a visibility of 13 miles or more, than are non-convection days, and are extremely unlikely to be accompanied by poor visibility, that is, a visibility of less than 2¼ miles.

Cumulus or Cumulo-Nimbus at or about 13 h.	Total No. of Observations.	Ground Horizontal Visibility at 13h.					
		13 miles or more.		2¼ miles or more but not reaching 13 miles.		Less than 2¼ miles.	
		Total No.	Per cent.	Total No.	Per cent.	Total No.	Per cent.
Present	1,028	508	49·4	517	50·3	3	0·3
Absent	436	110	25·2	310	71·1	16	3·7

WILLIAM H. PICK.

R.A.F. Station, Cranwell, Lincolnshire. November 15th, 1927.

The Lasting Qualities of Small Rubber Balloons

The article on the lasting qualities of rubber balloons in the November number of the *Meteorological Magazine* suggests that it may be of interest to some of your readers to know of a method of preventing rubber from perishing that has been in use at Helwan Observatory, Egypt, for many years. All objects of rubber, balloons, tubing, etc., are there stored in a chest which under a perforated shelf has a pan containing turpentine. Vapour from the turpentine keeps the rubber in a fresh and pliant state for years, though when exposed to the outside air in hot dry climates it hardens and perishes very quickly. I believe this simple but effective method is but little known.

H. KNOX-SHAW.

Radcliffe Observatory, Oxford, November 30th, 1927.

NOTES AND QUERIES

Dust Devils

In looking through meteorological literature relating to dust devils some time ago I was unable to find any definite observa-

tions of the direction of rotation of actual dust devils. In some cases the assertion was made that the dust devils usually rotated in a cyclonic direction ; in other cases it was asserted that the dust devils rotated sometimes in one direction and sometimes in another.

The meteorological services in the Middle East (Lower Egypt and Palestine) and in Iraq were therefore asked to note when possible the actual direction of rotation of dust devils and any other features of interest in connexion with them. The direction of rotation was specified as cyclonic if the direction was in the same sense as that of the winds in a cyclone and anticyclonic if the rotation was in the same sense as the winds in an anticyclone (of the Northern Hemisphere). It appears from the reports of actual observations from April to October, 1927, that the rotation is sometimes in one direction and sometimes in another. Out of the reports of 54 dust devils which have been received from Middle East, 26 were cyclonic and 24 were anticyclonic ; in the remaining 4 the direction of rotation was not determined. Out of 33 dust devils of which reports have been received from Iraq, 17 were cyclonic and 11 were anticyclonic ; in the remaining 5 the direction of rotation was not determined. The majority of the dust devils observed occurred in the months May-September.

The estimated heights of dust devils vary considerably. In some cases they are estimated to be as low as 10 or 20 feet ; in other cases as high as 2,000 feet or 3,000 feet. The speed with which they move also varies considerably. It may be as low as 4 miles per hour ; it may be as high as 30 miles per hour. On one or two occasions dust devils have passed in very close proximity to the observation stations. On May 24th, 1927, a dust devil moving at a speed of 30 to 35 miles per hour from west to east, passed through the enclosure in which the meteorological hut at Abu Sueir is situated. It produced a gust of 35 miles per hour on the anemobiagraph and the microbarograph record fell suddenly about half an inch on the chart and rose again immediately. This corresponds roughly with a depression of about 1 millibar in the pressure. The direction of rotation was cyclonic and the height was estimated to be 1,000 feet. Another dust devil which passed quite close to the hut at Abu Sueir on July 29th was moving from north to south with a speed of 20 to 25 miles per hour. On this occasion the barograph chart showed a fall of pressure of about one millibar and the anemobiagraph a gust of 30 miles per hour. The direction of rotation of this devil was anticyclonic and its height was estimated to be 150 feet.

A complete discussion of the observations has not yet been

made, but these facts may be of interest to the readers of the *Meteorological Magazine.*

E. GOLD.

Abnormal Rainfalls

In the article under the above title in the *Meteorological Magazine* for February, 1927, on page 4, is quoted an amount of 35·7 in. at Beerwah, Queensland, on February 2nd, 1893. Mr. Inigo Jones, who recorded the observation referred to, writes that the station is not really Beerwah, which is on the coast flats and has not so much rain, but Crohamhurst, in a valley basin formed by the Blackall and Durundur Ranges and facing south-east, which is the direction of the wind on the advancing quadrant of the tropical storms coming down the coast and hence is the chief rain-bearing wind. He also sends further details showing the following succession of heavy falls in 1893: January 30th, 2·368 in.; January 31st, 10·775 in.; February 1st, 20·056 in.; February 2nd, 35·714 in.; February 3rd, 10·76 in.; February 4th, 1·690 in. Other heavy falls at the same station were: 1898—January 9th, 19·415 in.; January 10th, 15·955 in.; March 6th, 16·230 in.; March 7th, 17·070 in.

The Rainfall of 1927

While popularly 1927 will be remembered as a year of dismal weather, the worst in a series of 6 consecutive wet years, those who keep statistics must join with the country gentleman who, when abruptly asked some 200 years ago by the taciturn Swift "Pray, sir, do you remember any good weather?" was able to answer "Yes, sir, . . I remember a great deal of good weather." The rainfall of 1927 has been exceeded in nearly all parts of the country by that of other years within living memory, and the year contained a number of unusually dry periods. During February there was less than half the average rainfall in the northern half of Scotland and in the north-east of England. May was generally dry and markedly so in the south and south-east of England, where the month was warm and sunny. In most districts also the first half of October was fine and dry. The year 1927 was unusually prolific in meteorological peculiarities to the last. In December, while the south-east of England experienced more than the average of rain and snow, the English Lake District and Scotland were relatively dry. In Keswick the total for the month was only 1·45 in. or just over 20 per cent. of the average. Over Scotland generally it was the driest December since before 1870 with the one exception of that of 1890.

Over the British Isles the rainfall exceeded the average in every month, except May, October and December, but there was a well-

marked excess only in June, August and September. September was the wettest month of the year, although it was not as wet as that of 1918. Although the total rainfall of the six summer months was remarkably heavy, exceeding 150 per cent. of the average summer fall in the south-east of England and of Scotland, appreciably larger falls are on record in all parts of the British Isles. The run of wet months from June to September was the most striking feature of the rainfall of the year, being wetter over the British Isles generally than similar periods in any year back to 1879, when the fall was slightly greater.

One of the most unusual features of the rainfall during the year in London was the intense fall of over 3 in. during the afternoon thunderstorm of July 11th, when 2 in. fell in little over half an hour. The rainfall of August Bank holiday in the south-east of England was not remarkable, although its incidence influenced considerably the popular impression of the weather of the year. In London (Camden Square) the total for the year of 33·84 in. was 9·37 in. or 38 per cent. in excess of the average of the period 1881 to 1915. It was, however, the wettest year only since 1916, and the duration of rainfall, 568 hours, was exceeded as recently as 1919 and 1916.

There were considerable areas with less than the average during 1927 along the north-west coast of Scotland, from the Isle of Mull to Cape Wrath, in central and northern Ireland from Westmeath to Loch Foyle, and in the extreme south-west of Wales and of Ireland. The deficiencies were everywhere less than 10 per cent. Over Ireland more than 110 per cent. occurred over large areas in Connemara, round Cork and Mallow and along parts of the east coast, but the fall does not appear to have exceeded 120 per cent. In Scotland falls exceeding 120 per cent. were wide-spread in the south-east and east, while rather more than 130 per cent. was recorded in the neighbourhood of Edinburgh and Haddington. In England and Wales there was more than 130 per cent. over three well defined areas, part of Dartmoor, a narrow strip from Worcester to Northampton and a much larger area stretching from Bath to Oxford in the north-west to Ventnor, Brighton and Folkestone in the south. In the last mentioned area falls exceeding 140 were widespread. At High Wycombe the total was the largest for 80 years.

From the information at present available the following general values for 1927 have been computed :—

England and Wales ..	43·8 in.	124	per cent. of average 1881-1915
Scotland	57·2 in.	114	
Ireland	46·2 in.	107	
British Isles	48·9 in.	118	

The annual values were considerably exceeded for Scotland and Ireland in 1924, and for England, in 5 years out of the last 100,

namely 1903, 1882, 1872, 1852 and 1848, when the computed values were 128, 127, 144, 137 and 129 per cent. of the average respectively. Over the British Isles generally 1927 was wetter than any year since 1903, though it differed little from 1924 and 1912. ——— J. GLASSPOOLE.

Obituary

William Henry Dines, F.R.S.—All readers of this magazine will have heard with profound regret of the death of Mr. W. H. Dines, which occurred on Christmas Eve at the Old Observatory, Benson, and will desire to express their sympathy with Mrs. Dines and with his two sons, who are our colleagues on the staff of the Office.

Interest in meteorology may almost be said to be hereditary in the Dines family, for Mr. Dines's father was the inventor of the dew-point hygrometer, which still goes by his name, and is described in most text-books of physics. To many of us it has constituted our first acquaintance with meteorology.

Mr. W. H. Dines was born in 1855. He served an apprenticeship as a railway engineer, and then proceeded to Corpus Christi College, Cambridge, where he read mathematics and graduated as a Wrangler in 1881. From that time onwards he devoted himself to meteorology, but did not hold an official position. He was in the true and best sense of the word an amateur, never seeking to enhance his personal reputation, still less to secure financial advantages for himself, but he has left an indelible impress on the progress of the science. Of an exceedingly reticent and retiring nature, he was essentially an individual worker, yet a great deal of his work was done in co-operation with others. His early work on wind pressure was in co-operation with the Wind Pressure Committee of the Royal Meteorological Society. It gave us the pressure-tube anemometer, which made it possible to measure transient gusts of wind, an indispensable preliminary to the development of our modern ideas of turbulence.

Dines had reached middle life when the observational study of the upper air came into its own. The material resources available for such work in this country were meagre in the extreme when compared with what was provided elsewhere, especially in Germany. The Joint Upper Air Committee of the British Association and the Royal Meteorological Society, which was responsible for inaugurating such work as could be undertaken here, was fortunate in securing Dines as its active worker. The early work was carried out with kites at Mr. Dines's house at Oxshott, or from a steam vessel off Crinan on the west coast of Scotland. No doubt, his engineering training stood him in good stead in developing his methods. He exhibited an almost uncanny facility in devising, at a minimum of cost, apparatus which worked and achieved the results which he had set out to

obtain. The story is set out with all modesty in his Presidential Address to the Royal Meteorological Society in 1903. Practically all the apparatus, kites, meteorographs, winches, &c., were made in Mr. Dines's own workshop, much of it by his own hands.

Subsequently the Meteorological Office was able to render more assistance, and Mr. Dines transferred his work to Pyrton Hill, and ultimately to Benson. The investigation of the higher regions of the atmosphere by means of registering balloons was included in the programme. Here Dines struck an entirely original line in the design of the meteorograph which he used. To economise weight he dispensed with the clock, which was used by all other workers in this field, and contented himself with obtaining a pressure-temperature record of the ascent on a scale so small that the curve had to be tabulated with the help of a reading microscope. This apparatus has made it possible for this country to contribute a large number of observations extending well into the stratosphere to the collection of data for international days collected under the auspices of the International Commission for the Exploration of the Upper Air. Dines's contribution to the study of the upper air was, however, not confined to the sphere of the observer and deviser of observational methods. He also took an active share in the discussion of the results.

In his later years he was impelled to the study of radiation and here again we find him active both as designer of instruments and as observer and student. It is gratifying to note that despite his failing health he was able to maintain his scientific interests almost up to the end, for it is only a few months since he contributed, with the co-operation of his son, L. H. G. Dines, a paper to the *Memoirs of the Royal Meteorological Society* on "Monthly Mean Values of Radiation from Various Parts of the Sky at Benson." Mr. Dines was elected a Fellow of the Royal Society in 1905, and was awarded the Symon's Gold Medal of the Royal Meteorological Society in 1914.

R. K. G. LEMPFERT.

The Weather of December, 1927

During the first half of the month the weather was generally unsettled with a moderate temperature, but later (except for a few days) the conditions became very cold and wintry, with frequent strong easterly winds and gales. For the first ten days pressure was high over Scandinavia and low on the Atlantic to the westward of the British Isles, and weather was generally dry in the eastern districts. On the 5th the Atlantic depression temporarily spread eastwards, causing mild conditions in most districts and southerly gales and much rain in the west and north. After the 6th the weather was cloudy, and temperature

fell gradually as the southerly winds backed to east. On the 14th a shallow depression moved eastward across southern Ireland and England, and rain, sleet or snow occurred in the south on the 13th and 14th. Heavy rain also fell in southern Ireland on the 16th, when as much as 3·16 in. were recorded at Aasleagh (Mayo) and 2·24 in. at Inagh (Clara). From the 11th pressure had been high over Iceland and Scandinavia, and now a wedge of high pressure extended southwards over the North Sea and Great Britain. Very cold air reached this country from northeast Europe*, and for five days from the 16th-20th inclusive temperature remained below freezing point day and night over a large area in southeast England, the Midlands and parts of Scotland. The lowest temperatures recorded during this period were 5° F. in the screen at Balmoral on the 17th and 18th, and −4° F. on the grass at Balmoral on the 17th. On the night of the 20th-21st heavy rain, associated with a deep depression which was advancing from the Atlantic, fell in the west, and on the morning of the 21st glazed frost occurred in the southeast districts. Precipitation amounted to 2·88 in. at Mourne (Down) and 2·65 in. at Treherbert (Glamorgan) on the 21st. Temperature rose rapidly, but the mild weather proved to be of only temporary character, and wintry conditions were renewed in the north on the 24th, in the south on the 25th. Heavy rain, sleet and snow occurred on the 25th and 26th, with a northeasterly gale in the south on the night of the 25th-26th. Wintry conditions then prevailed to the end of the month, except in the western districts, where milder conditions set in on the 31st.

Pressure was above normal over northwest Europe, Iceland, Spitsbergen and Bermuda, the greatest excess being 15·6 mb. at Thorshavn, and below normal over central and southwest Europe, most of the North Atlantic and the Azores, the largest deficits being 13·3 mb. at Lat. 50° N, Long. 30° W, and 10·9 mb. at Bayonne. This distribution was associated with easterly winds from the Baltic to the British Isles and north France. Temperature was below normal over the British Isles and southern Scandinavia and above normal over Spitsbergen, northern Scandinavia and Portugal. Precipitation was above normal over Spitsbergen, northern Norway and southern British Isles and below normal from southern Sweden to the northern British Isles.

Violent hailstorms destroyed part of the orange crop in districts round Valencia (Spain), and severe weather was also reported from Malaga and Castile on the 6th. At Castile there was a sudden change to fine weather on the 8th. Extreme cold

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* See p. 279.

occurred in Portugal early in the month. After three weeks' sunshine snow fell in Switzerland down to 3,000 ft. on the 12th. On the 18th a spell of very cold weather set in over the whole of Europe, thick snow occurred on the Riviera, and at Rome also there was a light covering of snow. In Germany and southeast Europe the cold was unusually severe. A glazed frost in Paris and neighbouring towns on the 21st and in Berlin on the 22nd, caused many accidents. This was the commencement of a general thaw, and the Föhn wind disposed of most of the snow up to 4,500 ft. in Switzerland. The gales in the North Sea, English Channel and parts of France caused much damage and held up communications between England and the Continent on the 27th and 28th, and an abnormally high tide, due to the sirocco, prevailed in the Bay of Naples on the 28th. Intense cold, frosty conditions again set in over central Europe about the 29th.

Serious floods were reported from northern Morocco from the 26th-31st, 1,800 sq. miles being under water. Relief was sent to the stranded people by means of aeroplanes.

Dense fog occurred over the Sea of Marmora on the 27th. A blizzard raged throughout western Japan on Christmas Eve, interrupting communications by land and sea.

Following torrential rains, the rivers in the Longreach district of Queensland were flooded on the 28th.

The gales, heavy snow and low temperatures which had been prevalent in Canada and the north-west of the United States extended on the 8th to the Middle West States, and the cold was felt as far south as the Gulf of Mexico. Many people have died in consequence of the cold and gales. Severe storms were also reported on the Great Lakes from the 8th to 10th, and the ice blockade was forming. Heavy rains on the 13th and 14th caused the Arkansas and White rivers to overflow.

Many severe gales occurred on the North Atlantic.

The special message from Brazil states that seven anticyclones passed across the country and the pressure distribution was very unstable and the weather unsettled but mainly dry. The rainfall was scarce, being 1·1 in., 1·9 in. and 2·2 in. below normal in the northern, central and southern districts respectively. All crops are suffering from lack of rain. Pressure at Rio de Janeiro was 0·3 mb. below normal and temperature 0·2° F. above normal.

Rainfall, December, 1927—General Distribution

England and Wales ..	95	per cent. of the average 1881-1915.
Scotland	44	
Ireland	75	
British Isles	78	

Rainfall: December, 1927: England and Wales

CO.	STATION.	In.	Per-cent. of Av.	CO.	STATION	In.	Per-cent of Av.
Lond.	Camden Square	4·17	175	*Leics*	Thornton Reservoir ..	2·22	83
Sur .	Reigate, The Knowle ..	5·90	197	,, .	Belvoir Castle	2·55	104
Kent.	Tenterden, Ashenden..	4·69	151	*Rut* .	Ridlington	2·33	...
,, .	Folkestone, Boro. San.	4·84	...	*Linc.*	Boston, Skirbeck	2·62	122
,, .	Margate, Cliftonville ..	2·87	126	,, .	Lincoln, Sessions House	2·73	125
,, .	Sevenoaks, Speldhurst.	5·94	...	,, .	Skegness, Marine Gdns.	2 55	116
Sus .	Patching Farm	4·76	142	,, .	Louth, Westgate	2·98	107
,, .	Brighton, Old Steyne .	4·44	143	,, .	Brigg	...	...
,, .	Tottingworth Park	5·02	136	*Notts.*	Worksop, Hodsock	2·34	99
Hants	Ventnor, Roy. Nat. Hos.	3·72	113	*Derby*	Derby	2·19	84
,, .	Fordingbridge, Oaklnds	4·31	109	,, .	Buxton, Devon. Hos...	1·94	34
,, .	Ovington Rectory	3·71	94	*Ches.*	Runcorn, Weston Pt...	1·71	54
,, .	Sherborne St. John ...	3·59	109	,, .	Nantwich, Dorfold Hall	1·44	...
Berks	Wellington College ...	3·64	126	*Lancs*	Manchester, Whit. Pk.	1·04	32
,, .	Newbury, Greenham ..	3·85	120	,, .	Stonyhurst College	1·23	25
Herts.	Benington House	2·83	114	,, .	Southport, Hesketh Pk	1·22	38
Bucks	High Wycombe	3·63	124	,, .	Lancaster, Strathspey.	1·14	...
Oxf. .	Oxford, Mag. College ..	3·38	146	*Yorks*	Wath-upon-Dearne ...	1·87	79
Nor .	Pitsford, Sedgebrook ..	2·51	104	,, .	Bradford, Lister Pk...	2·67	80
,, .	Oundle	2·39	...	,, .	Oughtershaw Hall	2·26	...
Beds.	Woburn, Crawley Mill.	2·52	108	,, .	Wetherby, Ribston H..	2·19	89
Cam.	Cambridge, Bot. Gdns.	2·04	106	,, .	Hull, Pearson Park ...	2·84	118
Essex	Chelmsford, County Lab	2·53	114	,, .	Holme-on-Spalding ...	2·27	...
,, .	Lexden, Hill House ...	2·47	...	,, .	West Witton, Ivy Ho..	3·32	...
Suff .	Hawkedon Rectory ...	2·40	99	,, .	Felixkirk, Mt. St. John	2·04	85
,, .	Haughley House	1·57	...	,, .	Pickering, Hungate ...	2·39	...
Norf.	Beccles, Geldeston	2·52	110	,, .	Scarborough	2·13	90
,, .	Norwich, Eaton	2·79	107	,, .	Middlesbrough	1·77	91
,, .	Blakeney	1·28	58	,, .	Baldersdale, Hury Res.	2·20	...
,, .	Little Dunham	2·22	91	*Durh.*	Ushaw College	3·22	129
Wilts.	Devizes, Highclere	3·09	101	*Nor* .	Newcastle, Town Moor.	4·44	184
,, .	Bishops Cannings	2·96	90	,, .	Bellingham, Highgreen	2·99	...
Dor .	Evershot, Melbury Ho.	5·05	98	,, .	Lilburn Tower Gdns...	3·67	...
,, .	Creech Grange	5·01	...	*Cumb*	Geltsdale	1·44	...
,, .	Shaftesbury, Abbey Ho.	3·54	98	,, .	Carlisle, Scaleby Hall .	·86	27
Devon	Plymouth, The Hoe ...	4·58	92	,, .	Seathwaite M.	...	...
,, .	Polapit Tamar	4·86	95	,, .	Keswick, High Hill...	1·45	...
,, .	Ashburton, Druid Ho..	6·51	86	*Glam.*	Cardiff, Ely P. Stn.....	3·02	59
,, .	Cullompton	3·51	80	,, .	Treherbert, Tynywaun	6·21	...
,, .	Sidmouth, Sidmount ..	4·00	102	*Carm*	Carmarthen Friary	3·97	69
,, .	Filleigh, Castle Hill ...	2·99	...	,, .	Llanwrda, Dolaucothy.	3·96	57
,, .	Barnstaple, N. Dev. Ath.	2·73	62	*Pemb*	Haverfordwest, School	4·12	72
Corn.	Redruth, Trewirgie ...	4·66	74	*Card.*	Gogerddan	3·09	61
,, .	Penzance, Morrab Gdn.	4·51	79	,, .	Cardigan, County Sch. .	2·49	...
,, .	St. Austell, Trevarna ..	5·00	82	*Brec.*	Crickhowell, Talymaes	4·40	...
Soms	Chewton Mendip	3·72	69	*Rad* .	Birm. W. W. Tyrmynydd	3·94	48
,, .	Street, Hind Hayes ...	2·74	...	*Mont.*	Lake Vyrnwy	2·85	42
Glos. .	Clifton College	3·42	89	*Denb.*	Llangynhafal	1·22	...
,, .	Cirencester, Gwynfa ..	3·43	102	*Mer* .	Dolgelly, Bryntirion ..	2·37	35
Here.	Ross, Birchlea	2·89	97	*Carn.*	Llandudno	1·69	55
,, .	Ledbury, Underdown.	2·28	81	,, .	Snowdon, L. Llydaw 9	3·37	...
Salop	Church Stretton	2·69	80	*Ang* .	Holyhead, Salt Island.	2·54	61
,, .	Shifnal, Hatton Grange	1·75	68	,, .	Lligwy	1·57	...
Worc.	Ombersley, Holt Lock.	2·33	89	*Isle of Man*			
,, .	Blockley, Upton Wold.	3·38	104		Douglas, Boro' Cem...	3·42	68
War.	Farnborough	2·52	86	*Guernsey*			
,, .	Birmingham, Edgbaston	2·87	107		St. Peter P't. Grange Rd	3·89	95

Rainfall: December, 1927: Scotland and Ireland

CO.	STATION.	In.	Per-cent. of Av.	CO.	STATION.	In.	Per-cent of Av.
Wigt.	Stoneykirk, Ardwell Ho	1·79	44	*Suth.*	Loch More, Achfary ...	1·33	14
„ .	Pt. William, Monreith .	2·42	...	*Caith*	Wick	·88	29
Kirk.	Carsphairn, Shiel.	2·14	...	*Ork .*	Pomona, Deerness	1·34	32
„ .	Dumfries, Cargen	2·16	40	*Shet .*	Lerwick	1·59	33
Dumf	Eskdalemuir Obs.....	...	...	*Cork.*	Caheragh Rectory	7·45	...
Roxb	Branxholm	2·17	59	„ ..	Dunmanway Rectory.	8·87	110
Selk .	Ettrick Manse.....	2·67	...	„ ..	Ballinacurra	6·50	127
Peeb.	Castlecraig	...	...	„ ..	Glanmire, Lota Lo. ...	7·68	140
Berk.	Marchmont House	2·72	95	*Kerry*	Valentia Obsy.	6·52	98
Hadd	North Berwick Res....	2·77	129	„ .	Gearahameen	6·90	...
Midl	Edinburgh, Roy. Obs..	1·44	67	„ .	Killarney Asylum.....	4·70	65
Ayr .	Kilmarnock, Agric. C..	·73	17	„ .	Darrynane Abbey	5·58	95
„ .	Girvan, Pinmore.....	1·60	27	*Wat .*	Waterford, Brook Lo..	5·73	122
Renf.	Glasgow, Queen's Pk..	·78	18	*Tip .*	Nenagh, Cas. Lough...	3·63	79
„ .	Greenock, Prospect H..	1·38	18	„ .	Roscrea, Timoney Park	1·49	...
Bute.	Rothesay, Ardencraig.	1·63	30	„ .	Cashel, Ballinamona ..	4·67	107
„ .	Dougarie Lodge	2·28	...	*Lim .*	Foynes, Coolnanes	3·49	74
Arg .	Ardgour House	·41	...	„ .	Castleconnell Rec.	3·26	...
„ .	Manse of Glenorchy..	·96	...	*Clare*	Inagh, Mount Callan ..	7·69	...
„ .	Oban	·26	...	„ .	Broadford, Hurdlest'n.	3·73	...
„ .	Poltalloch	1·29	20	*Wexf*	Newtownbarry	5·67	...
„ .	Inveraray Castle.....	·91	9	„ .	Gorey, Courtown Ho...	3·99	105
„ .	Islay, Eallabus	1·61	27	*Kilk.*	Kilkenny Castle	3·79	110
„ .	Mull, Benmore	...	...	*Wic .*	Rathnew, Clonmannon	3·86	...
„ .	Tiree	1·38	...	*Carl .*	Hacketstown Rectory .	3·41	83
Kinr.	Loch Leven Sluice	2·03	52	*QCo..*	Blandsfort House.....	3·27	89
Perth	Loch Dhu	2·65	26	„	Mountmellick	2·28	...
„ ..	Balquhidder, Stronvar.	2·09	...	*KCo.*	Birr Castle.....	2·16	66
„ ..	Crieff, Strathearn Hyd.	1·76	39	*Dubl.*	Dublin, FitzWm. Sq...	2·51	101
„ ..	Blair Castle Gardens ..	1·34	35	„ .	Balbriggan, Ardgillan .	2·35	81
Forf.	Kettins School.....	2·40	80	*Me'th*	Beauparc, St. Cloud ..	3·13	...
„ .	Dundee, E. Necropolis.	2·02	76	„ .	Kells, Headfort.....	2·63	69
„ .	Pearsie House.....	2·44	...	*W.M*	Moate, Coolatore.....	2·59	...
„ .	Montrose, Sunnyside..	2·79	100	„ .	Mullingar, Belvedere .	2·50	68
Aber.	Braemar, Bank	1·43	40	*Long*	Castle Forbes Gdns....	2·44	61
„ .	Logie Coldstone Sch. ..	1·83	65	*Gal .*	Ballynahinch Castle ..	3·15	42
„ .	Aberdeen, King's Coll..	2·46	76	„ .	Galway, Grammar Sch.	5·28	...
„ .	Fyvie Castle	3·22	...	*Mayo*	Mallaranny.....	4·11	...
Mor .	Gordon Castle.....	2·24	83	„ .	Westport House.....	4·92	86
„	Grantown-on-Spey....	1·34	49	„ .	Delphi Lodge	6·43	...
Na .	Nairn, Delnies.....	1.08	49	*Sligo*	Markree Obsy.	1·77	37
Inv..	Ben Alder Lodge	1·65	...	*Cav'n*	Belturbet, Cloverhill..	2·03	55
„ .	Kingussie, The Birches	·52	...	*Ferm*	Enniskillen, Portora ..	1·53	...
„ .	Loch Quoich, Loan	·50	...	*Arm.*	Armagh Obsy.	1·83	58
„ .	Glenquoich	·50	3	*Down*	Fofanny Reservoir	8·17	...
„ .	Inverness, Culduthel R.	1·24	...	„ .	Seaforde	4·39	107
„ .	Arisaig, Faire-na-Squir	·40	...	„ .	Donaghadee, C. Stn...	2·57	81
„ .	Fort William.....	·48	47	„ .	Banbridge, Milltown .	1·83	63
„ .	Skye, Dunvegan.....	1·12	...	*Antr.*	Belfast, Cavehill Rd. .	2·85	...
R&C	Alness, Ardross Cas. ..	1·71	41	„ .	Glenarm Castle.....	2·60	...
„ .	Ullapool.....	·07	...	„ .	Ballymena, Harryville	2·02	45
„ .	Torridon, Bendamph..	·50	5	*Lon .*	Londonderry, Creggan	1·12	26
„ .	Achnashellach	·49	...	*Tyr .*	Donaghmore	2·37	...
„ .	Stornoway	1·17	19	„ .	Omagh, Edenfel	1·60	38
Suth.	Lairg	1·11	...	*Don .*	Malin Head	1·61	18
„ .	Tongue	·90	18	„ .	Dunfanaghy	1·25	24
„ .	Melvich	·94	22	„ .	Killybegs, Rockmount.	2·26	31

Climatological Table for the British Empire, July, 1927

STATIONS	PRESSURE		TEMPERATURE							Relative Humidity	Mean Cloud Am'nt	PRECIPITATION			BRIGHT SUNSHINE	
			Absolute		Mean Values				Mean							
	Mean of Day M.S.L.	Diff. from Normal	Max.	Min.	Max.	Min.	½ max. and min.	Diff. from Normal	Wet Bulb.			Am'nt	Diff. from Normal	Days	Hours per day	Percentage of possible.
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	0—10	in.	in.			
London, Kew Obsy.	1012·7	− 3·1	79	45	68·4	55·0	61·7	− 1·0	56·7	86	8·3	3·00	+ 0·83	11	4·1	25
Gibraltar	1016·5	− 0·3	88	61	82·8	64·7	73·7	− 1·1	63·4	81	2·6	0·00	− 0·03	0	...	...
Malta	1014·2	− 1·1	94	73	86·3	75·0	80·7	+ 2·4	74·8	78	1·8	0·00	− 0·05	0	12·7	89
St. Helena	1017·1	+ 3·5	63	52	61·1	55·2	58·1	− 0·9	56·1	91	3·3	3·73	− 0·30	18	...	...
Sierra Leone	1014·6	+ 1·9	89	70	83·8	72·1	77·9	− 0·7	74·8	86	7·8	34·16	− 1·42	25	...	...
Lagos, Nigeria	1012·5	− 1·3	84	72	81·3	74·3	77·8	− 0·2	74·6	85	4·1	8·57	− 2·11	13	...	...
Kaduna, Nigeria	1015·6	+ 1·6	86	...	82·6	...	...	...	69·4	85	...	10·90	+ 2·70	20	...	...
Zomba, Nyasaland	1020·8	+ 2·3	77	43	70·9	50·3	60·6	− 1·4	...	70	5·6	0·05	− 0·30	2	...	...
Salisbury, Rhodesia	1021·3	+ 0·6	76	32	70·4	43·4	56·9	+ 0·8	50·2	56	2·8	0·01	− 0·02	1	8·6	77
Cape Town	1023·4	+ 2·1	85	38	64·1	48·8	56·5	+ 1·8	49·9	87	5·8	1·74	− 1·91	10	...	...
Johannesburg	1026·5	+ 1·9	74	33	61·4	40·1	50·7	+ 0·2	42·0	61	0·2	1·78	+ 1·45	3	8·9	84
Mauritius	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Bloemfontein	...	...	71	25	63·1	34·7	48·9	+ 1·6	37·9	67	1·5	0·37	− 0·01	2	...	...
Calcutta, Alipore Obsy.	998·3	− 0·9	94	76	89·2	79·2	84·2	+ 0·7	79·4	89	8·6	8·48	− 4·03	13*	...	...
Bombay	1003·1	− 0·8	87	77	84·4	78·4	81·4	+ 0·1	77·3	86	8·9	16·85	− 7·42	25*	...	...
Madras	1004·3	− 0·2	102	75	96·5	80·0	88·3	+ 0·9	75·1	64	7·8	1·17	− 2·77	6*	...	...
Colombo, Ceylon	1009·5	+ 0·3	87	72	85·4	76·8	81·1	0·0	77·7	79	8·4	2·87	− 3·56	11	6·4	51
Hongkong	1004·1	− 0·7	91	75	86·5	78·5	82·5	0·0	79·1	86	8·2	18·73	+ 5·35	24	5·2	39
Sandakan	...	...	92	73	88·5	75·9	82·2	+ 0·4	76·8	84	...	5·76	− 0·79	14	...	...
Sydney	1014·2	− 4·3	73	40	63·5	44·6	54·1	+ 1·4	45·5	64	2·1	0·30	− 4·54	4	7·3	72
Melbourne	1014·8	− 4·3	60	34	55·5	43·5	49·5	+ 0·9	45·6	80	6·8	2·83	+ 1·00	20	3·5	35
Adelaide	1017·3	− 3·1	67	37	59·4	44·9	52·1	+ 0·4	47·2	80	6·6	2·73	+ 0·08	15	4·4	44
Perth, W. Australia	1018·5	− 0·5	67	38	61·7	47·6	54·7	− 0·5	50·6	79	6·5	6·23	− 0·22	19	5·1	50
Coolgardie	1019·8	− 0·1	67	33	58·8	42·2	50·5	− 0·7	46·3	74	4·3	1·29	+ 0·38	13	...	...
Brisbane	1016·7	− 1·8	79	39	70·4	47·5	58·9	+ 0·4	50·0	63	2·5	0·52	− 1·82	4	8·6	81
Hobart, Tasmania	1010·8	− 3·0	59	32	51·6	41·6	46·6	+ 1·2	41·9	77	7·0	2·30	+ 0·16	24	3·1	33
Wellington, N.Z.	1010·6	− 3·3	60	32	53·9	42·9	48·4	+ 0·7	46·0	79	6·9	3·46	− 2·17	20	3·3	35
Suva, Fiji	1013·8	− 0·4	88	63	80·5	70·0	75·3	+ 1·7	70·5	82	6·8	3·47	− 1·13	19	5·3	48
Apia, Samoa	1012·3	+ 0·3	86	72	84·6	75·0	79·8	+ 2·6	75·8	77	4·0	3·36	+ 0·72	15	8·1	71
Kingston, Jamaica	1014·8	+ 0·1	92	71	89·5	73·5	81·5	− 0·2	72·1	82	4·9	3·41	+ 1·79	4	9·1	69
Grenada, W.I.	1010·6	− 2·6	89	72	86·1	75·3	80·7	+ 1·7	76·1	79	5·1	6·83	− 2·96	22	...	...
Toronto	1014·3	+ 0·2	91	47	78·3	59·3	68·8	+ 0·6	62·4	76	4·8	5·87	+ 2·83	9	8·9	59
Winnipeg	1015·0	+ 2·3	90	41	76·7	54·3	65·5	− 0·7	57·7	80	3·3	1·14	− 2·02	11	8·7	55
St. John, N.B.	1015·1	+ 1·4	79	45	67·3	54·0	60·7	+ 0·3	58·1	89	7·2	6·89	+ 3·26	16	5·0	33
Victoria, B.C.	1018·9	+ 2·2	89	50	67·5	52·2	59·9	− 0·4	52·0	54	3·9	0·21	− 0·15	3	11·3	72

*For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.

Winnipeg	1015·0	+ 2·5	80	41	56·7	34·5	65·5	— 0·7	37·7	80	3·3	1·14	— 2·02	11	8·7	55
St. John, N.B.	1015·1	+ 1·4	79	45	67·3	54·0	60·7	+ 0·3	58·1	89	7·2	6·89	+ 3·26	16	5·0	33
Victoria, B.C.	1018·9	+ 2·2	89	50	67·5	52·2	59·9	— 0·4	52·0	54	3·9	0·21	— 0·15	3	11·3	72

*For Indian stations a rain day is a day on which 0·1 in. or more rain has fallen.